What is claimed is:

1. A control apparatus for an on-vehicle generator provided with a stator winding and a field winding and driven to rotate by an on-vehicle engine, the control apparatus comprising:

a switching element configured to selectably and electrically connect or disconnect a current path between the field winding and a power supply to provide the field winding with current;

a storage element; and

a regeneration element configured to provide the storage element with current flowing through the field winding when the switching element is turned off.

2. The control apparatus according to claim 1, wherein the current flowing through the field winding when the current flowing through the field winding is supplied to the storage element is the same in a current flowing direction as the current flowing through the field winding when the power supply provides the field winding with current.

3. The control apparatus according to claim 2, wherein the field winding has two terminals, the power supply has positive and negative terminals, and the storage element has positive and negative pole terminals; wherein

the switching element is provided with a first switch placed to connect to one terminal of the field winding and the positive terminal of the power supply and a second switch placed to connect to the other terminal of the field winding and the negative terminal of the power supply; and

the regeneration element is provided with a first diode placed to connect to the one terminal of the field winding and the negative pole terminal of the storage element and a second diode placed to connect to the other terminal of the field winding and the positive pole terminal of the storage element.

4. The control apparatus according to claim 2, wherein the field winding has two terminals, the power supply has positive and negative terminals, and the storage element has positive and negative pole

terminals; wherein

the switching element is provided with a first switch placed to connect to one terminal of the field winding and the positive terminal of the power supply and a second switch placed to connect to the other terminal of the field winding and the negative terminal of the power supply;

the regeneration element is provided with a third switch placed to connect to the one terminal of the field winding and the negative pole terminal of the storage element and a fourth switch placed to connect to the other terminal of the field winding and the positive pole terminal of the storage element; and

an on/off control element configured to bring the third and fourth switches into an off-state when the first and second switches is in an on-state and to bring the third and fourth switches into an on-state when the first and second switches is in an off-state.

5. The control apparatus according to claim 4, wherein the on/off control unit is configured to turn off the third and fourth switches when the current flowing through the field winding becomes zero.

6. The control apparatus according to claim 4, wherein the on/off control unit is configured to turn on and off the first and second switches at intervals of time less than 1/10 of a time constant of the field winding.

7. The control apparatus according to claim 1, wherein the field winding has two terminals, the power supply has positive and negative terminals, and the storage element has positive and negative pole terminals; wherein

the switching element is provided with a first switch placed to connect to one terminal of the field winding and the positive terminal of the power supply and a second switch placed to connect to the other terminal of the field winding and the negative terminal of the power supply; and

the regeneration element is provided with a first diode placed to connect to the one terminal of the field winding and the negative pole

terminal of the storage element and a second diode placed to connect to the other terminal of the field winding and the positive pole terminal of the storage element.

8. The control apparatus according to claim 1, wherein the field winding has two terminals, the power supply has positive and negative terminals, and the storage element has positive and negative pole terminals; wherein

the switching element is provided with a first switch placed to connect to one terminal of the field winding and the positive terminal of the power supply and a second switch placed to connect to the other terminal of the field winding and the negative terminal of the power supply;

the regeneration element is provided with a third switch placed to connect to the one terminal of the field winding and the negative pole terminal of the storage element and a fourth switch placed to connect to the other terminal of the field winding and the positive pole terminal of the storage element; and

an on/off control element configured to bring the third and fourth switches into an off-state when each of the first and second switches is in an on-state and to bring the third and fourth switches into an on-state when each of the first and second switches is in an off-state.

9. The control apparatus according to claim 8, wherein the on/off control unit is configured to turn off the third and fourth switches when the current flowing through the field winding becomes zero.

10. The control apparatus according to claim 8, wherein the on/off control unit is configured to turn on and off the first and second switches at intervals of time less than 1/10 of a time constant of the field winding.

11. An on-vehicle power supply system comprising:

a control apparatus for an on-vehicle generator provided with a stator winding and a field winding and driven to rotate by an on-vehicle engine;

a power supply, and

a storage element electrically connected to the power supply in parallel,

wherein the control apparatus comprises:

a switching element configured to selectably and electrically connect or disconnect a current path between the field winding and a power supply to provide the field winding with current;

a storage element; and

a regeneration element configured to provide the storage element with current flowing through the field winding when the switching element is turned off.

12. The on-vehicle power supply system according to claim 11, wherein the current flowing through the field winding when the current flowing through the field winding is supplied to the storage element is the same in a current flowing direction as the current flowing through the field winding when the power supply provides the field winding with current.

13. The on-vehicle power supply system according to claim 12, wherein the field winding has two terminals, the power supply has positive and negative terminals, and the storage element has positive and negative pole terminals; wherein

the switching element is provided with a first switch placed to connect to one terminal of the field winding and the positive terminal of the power supply and a second switch placed to connect to the other terminal of the field winding and the negative terminal of the power supply; and

the regeneration element is provided with a first diode placed to connect to the one terminal of the field winding and the negative pole terminal of the storage element and a second diode placed to connect to the other terminal of the field winding and the positive pole terminal of the storage element.

14. The on-vehicle power supply system according to claim 12, wherein the field winding has two terminals, the power supply has

positive and negative terminals, and the storage element has positive and negative pole terminals; wherein

the switching element is provided with a first switch placed to connect to one terminal of the field winding and the positive terminal of the power supply and a second switch placed to connect to the other terminal of the field winding and the negative terminal of the power supply;

the regeneration element is provided with a third switch placed to connect to the one terminal of the field winding and the negative pole terminal of the storage element and a fourth switch placed to connect to the other terminal of the field winding and the positive pole terminal of the storage element; and

an on/off control element configured to bring the third and fourth switches into an off-state when each of the first and second switches is in an on-state and to bring the third and fourth switches into an on-state when each of the first and second switches is in an off-state.

15. The on-vehicle power supply system according to claim 14, wherein the on/off control unit is configured to turn off the third and fourth switches when the current flowing through the field winding becomes zero.

16. The on-vehicle power supply system according to claim 14, wherein the on/off control unit is configured to turn on and off the first and second switches at intervals of time less than 1/10 of a time constant of the field winding.